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Human Kinetics
ORIGINAL RESEARCH

Can You Swim in Clothes? Reflections on the Perception and Reality of the Effect of Clothing on Water Competency

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In the second phase of the project entitled *Can You Swim in Clothes?,* physical education students ($n = 37$) with known water proficiency completed an aquatics education program that included the wearing of clothes in simulated water survival activities. Using a modified version of Borg's Rating of Perceived Exertion (RPE), participants were asked to estimate their exertion levels before and after performing a range of clothing related water activities including a 50 m sprint, a 5 min survival swim, a 15 m underwater swim, and a 5 min survival float. Participants reported significantly higher exertion ratings postactivity than they had estimated for all activities, especially when clothed, irrespective of age, sex, or self-estimated water competency. Reasons for the underestimation of exertion, especially with regard to clothing are discussed. Ways of applying the protocols developed in this second phase of the project to other populations, especially those with less water competency and high-risk groups, are recommended.

Keywords: water competency, water safety, clothed swimming, rating of perceived exertion

Unintentional falls into water, often when fully clothed, are a frequent source of open water drowning. Yet little is known about the effect of clothing on water survival competencies such as swimming and floating in the prevention of drowning (Moran, 2014a). Moreover, little is known about neither how people perceive the physical exertion that such competencies may require if entering the water when clothed nor how close their perception is to the reality of actually performing the tasks when clothed. The first phase of the *Can You Swim in Clothes?* project set out to establish test protocols that would be capable of quantifying the demands of swimming and floating when wearing everyday clothes and then measuring the effects of clothing on those competencies. These first two aims were the focus of the first study previously reported (Moran, 2014a). The purpose of this second study is to report on a third aim—that of exploring the relationship between perceived and real effort required to complete a range of water competencies when wearing clothing.

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While research on what constitutes water competency in the context of drowning prevention has advanced in recent years (for example, Stallman, Junge, & Blixt, 2008; Moran, Stallman, et al., 2012), our understanding of people's perception of their competency (i.e., what they think they can do) and their perceived risk of drowning (i.e., the magnitude of the dangers they face) are still relatively unexplored. Several studies have postulated that the greater propensity for drowning among males is a consequence of their overestimation of their competency and underestimation of the risks of drowning in any given situation (for example, Gulliver & Begg, 2005; Howland, Hingson, Mangione, Bell, & Bak, 1996; Moran, 2008; Moran et al., 2012). No study has tested the possibility that these critical factors—underestimation of risk and overestimation of competency—may extend to the wearing of clothes, unintentional or otherwise, in a drowning situation. Furthermore, little is known about possible changes in perceptions as a consequence of participating in activities that simulate the impact of clothing on swimming and floating and whether preconceived ideas of the exertion differ from postactivity perceptions.

Ratings of perceived exertion (RPE) have long been used as a means of quantifying effort expended in performing physical tasks (Marriott & Lamb, 1996). Among the most prominent and enduring of the ratings is Borg's RPE scale designed to quantify subjective self-reported estimates of physical effort (Borg, 1970, 1977, 1982, 1998). The most widely used version, the 15-point scale with category indicators (Borg, 1982), has been extensively used with bicycle ergometry, treadmill exercises, track running, and competitive swimming. While the research literature has reported some inconsistencies about the use of ratings relative to physiological parameters (e.g., heart rate, blood lactate, and maximal oxygen uptake), ratings of perceived exertion have been shown to be a reasonably valid and robust measure of exercise intensity (Chen, Fan & Moe, 2002).

In the aquatic context, measures of perceived exertion have been used extensively in competitive swimming as a way of quantifying training pace/workload (Flynn, Pizza, Boone, Andres, Michaud, & Rodriguez-Zayas, 1994; Koltyn, O'Connor, & Morgan, 1991; Kurokawa & Ueda, 1992; Wallace, Slattery, & Coutts, 2009), comparing exertion with oxygen uptake, heart rate, and blood lactate concentration (Psycharakis, 2011: Ueda & Kurokawa, 1995; Invernizzi, Longo, Scurati, Maggioni, Michielon, & Bosio, 2014), for assessing different recovery modes (Buchheit, Al Haddad, Chivot, Lepetre, Ahmaidi, & Laursen, 2010), for comparing active and passive warmups (Psycharakis, 2014), and for assessing drafting effects (Chatard & Wilson, 2003). Perceived exertion also has been used for recreational fitness prescription (Green, Michael, & Solomon, 1999), for synchronized swimming (Rodríguez-Zamora, Iglesias, Barrero, Torres, Chaverri, & Rodríguez, 2014), for multisports and triathlons (Bentley, Libicz, Jougla, Coste, Manetta, Chamari, & Millet, 2007; Laursen, Rhodes, & Langill, 2000; Parry, Chinnasamy, Papadopoulou, Noakes, & Micklewright, 2011), and for exercise intensity in children's swimming (Ueda & Kurokawa,1991; Stallman, Laakso, & Kjendlie, 2011; Stallman, Laakso, & Hornemann, 2013; Laakso, Horneman, Grimstad, & Stallman, 2014).

While studies using RPE in an aquatic sports and exercise context are commonplace, studies of perceived exertion in a drowning survival situation are not. In early investigations, Tsubakimoto and colleagues (1992) and Choi and colleagues (1994) studied the effect of swimming in clothing on postexercise heart rate (HR).

Following these initial studies, Choi and colleagues used maximal oxygen uptake (VO_2) and RPE to compare swimming, using front crawl, breaststroke, and elementary backstroke, in swimwear and in clothes (Choi, Kurokawa, Ebisu, Kikkawa, Shiokawa, & Yamasaki, 2000). RPE increased linearly with $\%VO_2$ although no RPE differences were evident among the three swimming strokes when swimming in swimwear. At an exercise intensity above $60\%VO_2$, clothed swimmers showed slightly higher RPE in the front crawl stroke compared with the RPE in the two other swimming strokes. More recently, Antmann and colleagues used RPE to compare the effect of standard work clothing on the water competencies of speed swimming and treading water (Amtmann, Harris, Spath, & Todd, 2012). They found that standard labor wear had an adverse effect on sprint swimming (11.6 m), treading water time, and a significantly increased RPE for both tasks. Similar results were reported in the first phase of the current study (Moran, 2014a). Wearing lightweight clothes significantly reduced both sprint swimming speed (33% slower time) over a distance of 25 m and distance swum in 5 min (28% less distance) but no significant deterioration in flotation was found, irrespective of age or sex. Greater depreciation was noted in the sprint swim for those who self-reported low water competency.

Method

The study design chosen for this second phase of the *Can You Swim in Clothes?* project was a paired, repeated measures (test-retest) experimental design where the participants served as their own control. Ethics clearance for the study was obtained from the University of Auckland Human Participants Ethics Committee (UAHPEC) as part of the *Can You Swim in Clothes?* project (case number 010667).

Participants

Participants in this second phase of the clothing study were a cohort of students (n = 38) enrolled in a physical education undergraduate degree that included an aquatics education course as part of their professional teacher education degree. One participant did not complete part of the practical activity and was withdrawn from the final analysis (n = 37). The participants were volunteers with proven water competency proficiency (i.e., participants had passed the foundation aquatics program in their first year of study) and who agreed to take part in the study within their normal timetabled classes. The practical component was completed over 3 weeks during the summer term (March–April 2014). The heated (24 °C/75 °F) outdoor pool used was 25 m × 15 m with a 2 m deep end.

Procedures

Before the pool-based activities, students were asked to complete a questionnaire that, in addition to seeking information on their self-reported competency and confidence in water, asked them to estimate the level of exertion required to complete a range of water activities with/without clothing and when wearing a personal flotation device (PFD). To reduce the possibility of response bias, participants were not told that some of the survey questions related directly to the practical tasks they would undergo in the course of their aquatics program. Upon completion of the practical activities, all participants were asked to again provide an estimate of the levels of exertion required to perform each activity and to make comment on how they felt about any of the tasks performed.

The clothing worn was standardized and included the wearing of a t-shirt, long-sleeved sweatshirt, long-legged trousers/track pants, and swimwear underneath the clothing. Footwear and outer clothing was not included because of the possible effects the variability of the attire might have on performance (e.g., buoyancy of shoes, trapped air, and increased drag from outer clothing). The PFD was worn on top of swimwear only.

Four water competency tasks were selected—a 50 m sprint swim (for survival speed), a 5 min continuous swim (for survival endurance), a 15 m underwater swim (for breath control), and a 5 min stationary float in deep water (for survival endurance). Each competency task was performed when wearing swimwear, when wearing clothing, and when wearing swimwear and a personal flotation device (PFD), which totaled to 12 activities per person. Protocols developed in the initial phase of the study and previously reported (Moran, 2014a) were followed. Each activity (with swimwear in week 1, clothing in week 2, and swimwear/PFD in week 3) began with a deep water survival jump entry followed by a 50 m speed swim where participants were asked to swim as if escaping from an emergency situation using their fastest stroke. After 1 min of rest, participants were asked to swim continuously for 5 min using any stokes of their choice as strenuously as they could but to place priority on completing the full 5 min duration. Upon completion of the endurance swim, participants were given a further 1 min rest before attempting to swim underwater for a distance of 15 m from the shallow end (1 m) of the pool toward the deep end (2 m) using their preferred underwater swim technique. Finally, participants were asked to float in deep water for 5 min as efficiently as they could as if conserving energy in an open water survival situation. Because practical assessment of the selected water competency tasks among individuals was not part of this second phase of the study which focused on perceptions of exertion, participants undertook the activities in two groups (see Figures 1–4).

Figure 1 — Speed swim in clothes.

Figure 2 — Group 5 min swim in personal flotation devices.

Figure 3 — Underwater swim in personal flotation devices.

Research Instruments

Data were collected via a self-complete questionnaire based on the original *Can You Swim?* study (Moran et al., 2012) before engaging in the pool-based activities. The questionnaire sought information on sociodemographic characteristics (including age, sex, and ethnicity). Self-estimates of swimming competency included the use of a four-point scale of *high, good, low,* or *no competence,* an estimate of how far

Figure 4 — Group floating in personal flotation devices

participants thought they could swim nonstop in a pool, and a question on how confident they were of swimming their estimated distance in open water using a four point scale from *extremely confident* to *extremely anxious*.

Participants were asked to estimate, both pre- and posttesting, their predicted exertion in swimming/floating in swimwear and in clothing using a modified version of Borg's Ratings of Perceived Exertion (RPE) scale (Borg, 1970, 1977, 1982, 1998). The 15-point scale, where a low score indicates minimal exertion, was chosen because of its suitability for simple applied studies (Borg, 1982) such as the current study of perceived and real effort required in simulated drowning survival activities. Before the commencement of the pool-based activity, participants were made aware of a modified version of the scale that provided indicators of physical exertion in a water survival context (see Table 1).

The water survival indicators were closely aligned to the flotation test characteristics developed in the first phase of the *Can You Swim in Clothes*? study previously reported (Moran, 2014a, see p .343). In addition, three drowning prevention experts, familiar with the *Can You Swim?* study and Borg's RPE scale, were asked to critique the application of the RPE scale to the proposed water safety activities. The draft scale was then pilot tested on a group of 12 students not taking part in the clothing study. As a consequence of their input, some descriptors (such as "increased pulmonary ventilation") were changed to more user friendly language (such as "increased breathing rate and depth").

Data Gathering and Analysis

Preactivity data on all 12 activities were gathered before the pool-based program and then at the end of each weekly session in swimwear, in clothes, and when

Table 1 Borg's 15-Point Scale for Rating Modified for Water Survival

Rating	Category	Water Survival Indicators
6		
7	Very, very light	*Very relaxed survival situation, no compromised airway, relaxed breathing, comfortable facial expression and body position*
8		
9	Very light	*Easy survival situation, no compromised airway, relaxed breathing, comfortable facial expression and body position, minimal increase in work output to complete task*
10		
11	Fairly light	*Fairly easy survival situation, no compromised airway, slight increase in breathing rate and depth, comfortable facial expression and body position, some increase in work output to complete task*
12		
13	Somewhat hard	*Some facial signs of greater demand, maintains airway and work output, but greater concentration on task. Increased breathing rate and depth, increased effort to complete task*
14		
15	Hard	*Uncomfortable, some signs of facial distress, maintains airway, work output and body position, high energy output to complete task*
16		
17	Very hard	*Very uncomfortable, clear signs of anxiety compromised airway, breathing inefficient, poor body position, diminished work output*
18		
19	Very, very hard	*Extremely uncomfortable, highly compromised airway, gasping breathing, extremely inefficient body position, extremely diminished work output*
20		

wearing a PFD. All data were double-entered and cleaned in Microsoft Excel and then transferred to SPSS (Version 22, Armonk, NY, USA) for statistical analysis. Descriptive statistics were reported via numbers and percentage. Measures of central tendency used included mean (*M*), median (*Mdn*), standard deviation (*SD*), and mean differences (*Mdiff*). Chi-square tests were used to determine relationships between independent (such as age and sex) and dependent variables (such as preactivity RPE). To determine whether the (a) dependent sample *t* test or (b) Wilcoxon paired single ranks test was appropriate, an assessment of the estimated population normality of the pre- and posttest differences was undertaken. The Shapiro-Wilk's test was used to determine whether the sample differences came from a normally distributed population (Shapiro & Wilk, 1965). Results of the test revealed that only three of the 12 differences came from normally distributed populations (i.e., tests carried out at the $p < .05$ level). Therefore, the Wilcoxon Paired single ranks test was deemed the most appropriate test to assess the significance of the differences between the 12 pre- and posttest values.

In addition to reporting the level of exertion after completing the pool-based tasks, participants were asked to provide written comments about their expectations and experiences of performing in swimwear, in clothes, and when wearing a PFD. Where participants' comments shed new insights into our understanding of drowning survival perceptions and its role in water safety education, they are reported verbatim in the Discussion section of this paper.

Results

The participants ($n = 37$) were young adults (20–25 years of age) with most (87%) aged between 19–22 years of age. More than half (57%) were male ($n = 21$), and most (79% of participants) self-reported their water competency as good (49%) or high (30%). When asked to estimate how far they could swim without stopping, almost half (49%) estimated they could swim 200 m or more, with more than one third (38%) estimating they could swim more than 300 m. Most (68%) were confident of their ability to swim this distance in open water, and no sex difference was evident in perceived open water swimming competence (males 71%, females 65%). When asked if they had ever experienced a life-threatening submersion experience (LTSE), 41% reported that they had, but no significant difference was evident between male and female experience.

Speed Swim (50 m)

Table 2 shows the differences in perceptions of predicted and actual exertion when swimming for speed in swimwear, in clothing, and when wearing a PFD and swimwear. Wilcoxon signed ranks testing showed statistically significant increases in perceived exertion pre- and postspeed swimming over 50 m in swimwear (Z = -4.690, $p = < 0.001$), in clothing (Z = -5.322, $p = < 0.001$), and when wearing a PFD (Z = -5.038, $p = < 0.001$). Table 6 shows that mean and median scores of perceived exertion for all sprinting activities were higher than those predicted before performing the speed swim.

Table 2 Pre- and Postactivity Ratings of Perceived Exertion for Speed Swimming (50 m) in Swimwear, Clothing, and a Personal Flotation Device

RPE Score	Preactivity Speed Swim (Swimwear) *n*/%		Postactivity Speed Swim (Swimwear) *n*/%		Preactivity Speed Swim (Clothing) *n*/%		Postactivity Speed Swim (Clothing) *n*/%		Preactivity Speed Swim (PFD) *n*/%		Postactivity Speed Swim (PFD) *n*/%	
≤ 6	1	(2.7%)	-	-	-	-	-	-				
7–8	22	(59.5%)	14	(37.8%)	5	(13.5%)	-	-	10	(27.0%)	2	(5.4%)
9–10	12	(32.4%)	10	(27.0%)	23	(62.2%)	3	(8.1%)	18	(48.6%)	5	(13.5%)
11–12	2	(5.4%)	5	(13.5%)	5	(13.5%)	2	(5.4%)	5	(13.5%)	6	(16.2%)
13–14	-	-	6	(16.2%)	3	(8.1%)	8	21.6%)	3	(8.1%)	15	(40.5%)
15–16	-	-	2	(5.4%)	1	(2.7%)	11	(29.7%)	1	(2.7%)	6	(16.2%)
17–18	-	-	-	-	-	-	11	(29.7%)	-	-	3	(8.1%)
19–20	-	-	-	-	-	-	2	(5.4%)	-	-	-	-

Note. RPE = ratings of perceived exertion; PFD = personal flotation device.

Endurance Swim (5 min)

Table 3 shows that the differences in perceptions of predicted and actual exertion when swimming for endurance in swimwear, in clothing, and when wearing a PFD and swimwear. Wilcoxon signed ranks testing showed statistically significant increases in perceived exertion pre- and postendurance swimming in swimwear (Z = -5.056, p = < 0.001), in clothing (Z = -5.321, p = < 0.001), and when wearing a PFD (Z = -5.108, p = < 0.001). Table 6 shows that mean and median scores for all endurance swimming activities were higher than those predicted before performing the 5 min swim.

Flotation (5 min)

Table 4 shows that the differences in perceptions of predicted and actual exertion when survival floating for 5 min in swimwear, clothing, and when wearing a PFD and swimwear. Wilcoxon signed ranks testing showed statistically significant increases in perceived exertion pre- and postendurance swimming in swimwear (Z = -4.222, p = < 0.001), in clothing (Z = -4.785, p = < 0.001), and when wearing a PFD (Z = -3.597, p = < 0.001). Table 6 shows that mean and median scores for all flotation activities were higher than those predicted before performing the 5 min floating tasks.

When analyzed by sex, males were more likely than females to anticipate a higher level of exertion level before completing the floating activities in swimwear (χ^2 (5) = 12.373, p = .030) and clothing (χ^2 (5) = 18.733, p = .009), irrespective of age or competency. Significant differences were found when postactivity floating ratings were analyzed by sex (χ^2 (10) = 20.668, p = .024) with more males than females above the median score of 12 (males 76%, n = 16; females 56%, n = 9).

Underwater Swim (15 m)

Table 5 shows that the differences in perceptions of predicted and actual exertion when swimming underwater for 15 m in swimwear, clothing, and when wearing a PFD and swimwear. Wilcoxon signed ranks testing showed statistically significant increases in perceived exertion pre- and postunderwater swimming in swimwear (Z = -4.805, p = < 0.001), in clothing (Z = -5.008, p = <0.001), and when wearing a PFD (Z = -5.256, p = < 0.001). Table 6 shows that mean and median scores for all underwater swimming activities were higher than those predicted before performing the underwater swims. The differences in estimates were especially disparate when wearing a lifejacket, with posttest ratings much greater than pretest estimates (pretest m = 10.1; posttest m = 16.3).

Table 6 displays a summary of the results of the differences between the pre- and posttests for all 12 water competency tasks. Results show that the differences between the pre- and posttests were significant beyond the $p \leq .001$ level. This suggested that, overall, the posttest levels of exertion were much higher than the pretest levels for the 37 subjects.

When estimates of the RPEs of the 12 items before doing the activities were combined and Chi-square tested by sex, age, and self-reported swimming competency, no significant differences were found. Similarly, no significant differences were found when all scores postexercise were combined and analyzed against sex, age, and self-reported competency.

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Table 3 Pre- and Postactivity Ratings of Perceived Exertion for Endurance Swimming (5 min) in Swimwear, Clothing, and a Personal Flotation Device

RPE Score	Preactivity 5 Min Swim (Swimwear) *n*/%		Postactivity 5 Min Swim (Swimwear) *n*/%		Preactivity 5 Min Swim (Clothing) *n*/%		Postactivity 5 Min Swim (Clothing) *n*/%		Preactivity 5 Min Swim (PFD) *n*/%		Postactivity 5 Min Swim (PFD) *n*/%	
≤ 6	1	(2.7%)	1	(2.7%)	-	-	-	-				
7–8	11	(29.7%)	4	(10.8%)	-	-	-	-	7	(18.9%)	1	(2.7%)
9–10	18	(48.6%)	12	(32.4%)	7	(18.9%)	-	-	16	(43.2%)	8	(21.6%)
11–12	6	(16.2%)	10	(27.0%)	11	(29.7%)	-	-	11	(29.7%)	11	(29.7%)
13–14	-	-	5	(13.5%)	8	(21.6%)	3	(8.1%)	1	(2.7%)	8	(21.6%)
15–16	-1	(2.7%)	3	(8.1%)	9	(24.3%)	15	(40.5%)	-	-	6	(16.2%)
17–18	-	-	2	(5.4%)	2	(5.4%)	14	(37.8%)	2	(5.4%)	2	(5.4%)
19–20	-	-	-	-	-	-	5	(13.5%)	-	-	1	(2.7%)

Note. RPE = ratings of perceived exertion; PFD = personal flotation device.

Table 4 Pre- and Postactivity Ratings of Perceived Exertion for Survival Floating (5 min) in Swimwear, Clothing, and a Personal Flotation Device

RPE Score	Preactivity Floating (Swimwear) *n*/%		Postactivity Floating (Swimwear) *n*/%		Preactivity Floating (Clothing) *n*/%		Postactivity Floating (Clothing) *n*/%		Preactivity Floating (PFD) *n*/%		Postactivity Floating (PFD) *n*/%	
≤ 6	10	(27.0%)	10	(27.0%)	3	(8.1%)	3	(8.1%)	14	(37.8%)	15	(40.5%)
7–8	17	(59.5%)	9	(24.3%)	14	(37.8%)	10	(27.0%)	10	(54.1%)	17	(45.9%)
9–10	8	(32.4%)	8	(21.6%)	11	(29.7%)	2	(5.4%)	3	(9.1%)	4	(10.8%)
11–12	1	(2.7%)	4	(10.8%)	7	(18.9%)	4	(10.8%)	-	-	1	(2.7%)
13–14	1	(2.7%)	3	(8.1%)	-	-	9	(24.3%)	-	-	-	-
15–16	-	-	2	(5.4%)	2	(5.4%)	5	(13.5%)	-	-	-	-
17–18	-	-	-	-	-	-	1	(2.7%)	-	-	-	-
19–20	-	-	1	(2.7%)	-	-	3	(5.4%)	-	-	-	-

Note. RPE = ratings of perceived exertion; PFD = personal flotation device.

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Table 5 Pre- and Postactivity Ratings of Perceived Exertion for Underwater Swimming (15 m) in Swimwear, Clothing, and a Personal Flotation Device

RPE Score	Preactivity Underwater (Swimwear) *n*/%		Postactivity Underwater (Swimwear) *n*/%		Preactivity Underwater (Clothing) *n*/%		Postactivity Underwater (Clothing) *n*/%		Preactivity Underwater (PFD) *n*/%		Postactivity Underwater (PFD) *n*/%	
≤ 6	7	(18.9%)	6	(16.2%)		-	-	-	-	-	-	-
7–8	23	(62.2%)	18	(48.6%)	9	(24.3%)	3	(8.1%)	4	(10.8%)	-	-
9–10	6	(16.2%)	7	(18.9%)	14	(37.8%)	10	(27.0%)	18	(48.6%)	1	(2.7%)
11–12	1	(2.7%)	5	(13.5%)	11	(29.7%)	9	(24.3%)	8	(21.6%)	2	(5.4%)
13–14	-	-	1	(2.7%)	2	(5.4%)	7	(18.9%)	4	(10.8%)	7	(18.9%)
15–16	-	-		-	1	(2.7%)	3	(8.1%)	2	(5.4%)	10	(27.0%)
17–18	-	-		-	-	-	4	(10.8%)	1	(2.7%)	12	(32.4%)
19–20	-	-		-	-	-	1	(2.7%)	-	-	5	(13.5%)

Note. RPE = ratings of perceived exertion; PFD = personal flotation device.

Table 6 Summary of Differences Between Pre- and Postactivity Ratings of Perceived Exertion

		M	*SD*	*Mdn*	*Mean diff*	*Z*	*p*
50 m speed swim (swimwear)	Preactivity	7.97	1.32	7	-2.35	-4.690	< 0.001
	Postactivity	10.32	2.74	10			
50 m speed swim (clothing)	Preactivity	9.32	1.51	9	-6.08	-5.322	< 0.001
	Postactivity	15.43	2.43	16			
50 m speed swim (PFD)	Preactivity	9.35	1.93	9	-4.08	-5.038	< 0.001
	Postactivity	13.43	2.58	14			
5 min swim (swimwear)	Preactivity	9.00	1.67	9	-3.03	-5.056	< 0.001
	Postactivity	12.03	2.90	12			
5 min swim (clothing)	Preactivity	12.24	2.27	12	-4.76	-5.321	< 0.001
	Postactivity	17.00	1.51	17			
5 min swim (PDF)	Preactivity	9.84	2.58	9	-3.54	-5.108	< 0.001
	Postactivity	13.38	2.51	14			
5 min floating (swimwear)	Preactivity	7.56	1.56	7	-2.06	-4.222	< 0.001
	Postactivity	9.62	3.31	10			
5 min floating (clothing)	Preactivity	8.86	2.21	9	-5.14	-4.785	< 0.001
	Postactivity	12.03	3.97	12			
5 min floating (PFD)	Preactivity	6.89	0.97	7	-0.65	-3.597	< 0.001
	Postactivity	7.54	1.48	8			
15 m underwater (swimwear)	Preactivity	7.35	1.11	7	-1.51	-4.805	< 0.001
	Postactivity	8.86	1.93	8			
15 m underwater (clothing)	Preactivity	9.41	1.79	9	-3.16	-5.088	< 0.001
	Postactivity	12.57	3.12	12			
15 m underwater (PFD)	Preactivity	10.11	2.13	9	-6.19	-5.256	< 0.001
	Postactivity	16.30	2.40	16			

Note. PFD = personal flotation device.

Discussion

The primary purpose of this second phase of the *Can You Swim in Clothes?* project was to explore the relationships among perceived and real estimates of exertion required to perform a series of water competency tasks with and without clothes and when wearing a PFD. Using a modified Borg RPE 15-point scale with descriptors based on protocols developed for water-based activity in the first phase of the study (Moran, 2014a), participants reported higher exertion ratings postactivity than they had before the activity was undertaken for all 12 activities, irrespective of age, sex, or self-estimated water competency.

In the sprint swim for speed over 50 m, postactivity exertion ratings differed significantly when performed in both swimwear and when wearing a PFD, but the greatest change was evident when participants were wearing clothing (Table 6). Participants commented on the increased exertion required for the sprint with statements such as, "I knew swimming in clothes would be more difficult, but I found the sprint very hard because I chose to do front crawl . . . the last 10 m I thought I was going to blow!" and "I never realized how hard swimming freestyle at pace would be in clothes, [it] opened my eyes to how easily people drown in accidental submersion." Another reported, "I know I'm not a strong swimmer but I wasn't prepared for the effect the clothes had on my arms, I could hardly lift them out of the water at the end of the sprint." These comments reinforce previous findings about increased demands and reduced capacity when speed swimming clothed (Amtmann et al., 2012; Choi et al., 2000; Moran, 2014a).

In the 5 min endurance swim, postactivity ratings for the clothed swim again differed markedly pre- and postactivity when compared with the swim in swimwear and PFD. The clothed endurance swim produced the highest levels of exertion postactivity with a median score of 17 (compared with postexercise median scores of 12 and 14 for swimwear and PFD swims), irrespective of age, sex, or self-estimated water competency (Table 6). Furthermore, the clothed endurance swim was given the highest exertion rating of all 12 activities done and evoked the greatest number of written comments (n = 26) regarding the severity of the task. One male participant reported the demand as, "I'm not a strong swimmer although I am very aerobically fit, but this was the hardest thing I have ever done!" A competent female swimmer suggested that "I'm pretty capable and swim regularly, but I found the distance swim hard work because I chose to do front crawl most of the way. I wish now I had changed to breaststroke earlier." Previous studies by the author (Moran 2014a) and Choi and colleagues (2000) both reported greater exertion and reduced performance in the clothed swims when using front crawl. Given the strength of feelings reported here about the level of exertion required to perform a clothed swim over time, it would appear that concerns raised by the author (Moran, 2014a) about appropriate stroke selection in a survival situation requiring prolonged swimming endurance are justified and require further scrutiny.

Perhaps not surprisingly, the 5 min flotation activity, although producing significant differences in pre- and postactivity exertion ratings, was reported as the least strenuous activity in swimwear, in clothes, and in a PFD (Table 6). Nevertheless, analysis of the postexercise exertion scores suggested males are more likely than females to find floating in swimwear and clothing challenging. One competent male swimmer commented, "Floating in clothes was extremely difficult; I really struggle to float in swimwear alone! By doing this activity, it was a major eye-opener, as I didn't realize how hard it would be in a survival situation." Another male suggested "It really shocked me, as I genuinely believe I would not survive in the water for an extended period of time with clothes on." Previous studies have reported reduced floating time among participants wearing heavy work gear (Amtmann et al., 2012) but no significant difference in floating performance when wearing lightweight clothing (Moran, 2014a). Further study is required with differing types and quantity of clothing and more varied swimming competency before firm recommendations can be made about survival floating in clothes.

As was the case in all previous activities, the 15 m underwater swim elicited significantly greater exertion ratings postactivity, but Table 6 shows that the greatest mean difference was found when performing the underwater swim wearing a PDF rather than in swimwear or clothing (-6.19 compared with -1.151 and -3.16 respectively). Many students had difficulty combating the buoyancy of the PFD and maintaining an underwater position. One participant suggested, "I kept popping up no matter how hard I tried to stay underwater. I'd be in trouble if I had to swim under something submerged." Another wrote, "Even as a good swimmer I struggled to swim underwater with the lifejacket on, but after a bit of practice I got the hang of it." The task of swimming underwater when wearing a protective garment designed to do exactly the opposite caught many participants by surprise and prompted one to suggest that "We are always told to wear lifejackets to survive but never taught how to change our swimming technique to go underwater should that be necessary to escape from something—it should be taught in schools."

Given the evidence of a male propensity to overestimate ability and underestimate risk in the initial *Can You Swim?* project (Moran et al., 2012) and other studies (for example, Gulliver & Begg, 2005; Howland et al., 1996; Moran, 2008, 2014b), it is surprising that males in the present clothing study did not appear to differ significantly from females in their preactivity estimates of exertion required to compete most tasks. Indeed, males appeared to accurately predict greater exertion in the floating tasks in swimwear and in clothing, an expectation entirely plausible given their lesser buoyancy than their female counterparts. One possible reason for this is that the males were more likely to be aware of the physical demands about to be placed upon them because of their previous experiences with swimming and floating activity in their undergraduate study. Further research with populations not possessing prior knowledge and experience of water competency assessment is recommended.

Limitations

While the results of this study offer a number of valuable insights on how clothing influences perceptions of surviving the threat of drowning, several limitations should be considered when applying the findings to drowning prevention education. First, as was the case in the first study in this series, the nonrandomized order of trials may have caused an order effect. It is recommended that future studies address this limitation by randomly reversing the order of testing for half of the participants. Second, the practical activities were developed and tested using participants with known water competencies; further testing of people with more diverse capacities is required before the full effects of clothing on survival are known. Third, the participants in this study were part of a physical education degree program, perhaps more accustomed to physical exertion than other populations, so the use of a modified ratings scale based on Borg's Rate of Perceived Exertion (RPE) may have under-reported real exertion (Marriott & Lamb, 1996). Further exploration using a more representative sample may refute /support such speculation. Fourth, the testing took place in relatively benign water conditions; further testing in more hostile open water conditions is required. Fifth, the clothing used in this phase of the project was lightweight and did not include external clothing layers or footwear; it is possible therefore that perceptions of exertion reported here may not reflect the reality of everyday clothing on water survival. Sixth, and finally, because the demands of the clothed water activity were known, it was not possible to replicate the surprise element of unintentional immersion. These limitations notwithstanding, the findings of this second phase of the *Can You Swim in Clothes?* project provide valuable insights into the gap between perceived and real demands of survival in water.

Conclusion

This is the first study of its kind to explore the relationship between perceived and real energy demands before and after the completion of a series of water competencies related to drowning survival. The results clearly indicated that all participants, classified as competent swimmers, considered the tasks more demanding than they had anticipated once they had experienced the activity. This raises interesting challenges to those engaged in water safety teaching and learning. First, it would appear prudent to expose learners to numerous and repeated activities that simulate drowning survival (such as swimming and floating in clothes and when wearing PFDs). The experience may help establish appropriate survival strategies and decision making, especially where the immersion is unintentional and sudden. Second, it may provide more realistic appreciation of the demands of survival and inculcate more accurate estimations of the personal competencies that may be required in an emergency. Engaging learners in estimations of exertion using scales such as those developed in this study before and after experiencing suitable water-based survival challenges may help address a common problem, that of overestimation of ability to cope with the risk of drowning. The activities and protocols developed in this study warrant further application with different populations and in different settings—closing the gap between real and imagined survival demands is a challenge too important to be left to chance.

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